Appendix 3.4

Terrestrial Habitat Issue Analysis Report

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Issue Statement: Excessive road density (miles of roads per square mile) in some areas adversely affects the quality of wildlife habitat. This can lead to fragmented habitat and disturbance to the species. Roads also serve as invasion routes for noxious weeds, which can have severe, long-term impacts on ecosystem conditions and processes. Sensitive plant populations located near or adjacent to roads can be impacted by road maintenance and dust created from the use of the roads.

Key Questions for Terrestrial Habitat Issue

1. What are the direct effects of the road system on terrestrial species habitat?
2. How does the road system facilitate legal and illegal human activities that affect habitat (including trapping, hunting, poaching, harassment, road kill, illegal kill levels, plant collections) and how does this affect terrestrial species?
3. How does the road system directly affect unique communities or special features in the area and the species that occupy them?
4. How do roads affect the spread of undesirable exotic species?
5. What measure can be taken to prevent the spread of invasive plants along accessible areas?

<u>Wildlife Species</u>

The Forest road system and human use of the roads has altered and continues to alter terrestrial species habitat. Access to the forest created by the road system generates both negative and positive effects on terrestrial species and their habitats. Negative effects to the species or their habitat include both direct and indirect effects. Direct effects can include habitat loss and fragmentation. Indirect effects may include habitat avoidance, road kill or over-hunting. Positive impacts of roads on terrestrial species include habitat protection from wildfire and habitat treatments designed to improve habitat quality, both of which are greatly facilitated by road access.

Road construction can convert large areas of habitat to non-Forest (Hann et al. 1997 and Reed et al. 1996). Forest fragmentation can threaten native species populations by breaking up blocks of continuous habitat and by degrading the quality of the remaining habitat for those species sensitive to an increase in the amount of forest edge (Mader 1984, Reed et al. 1996). However, species that use edge will benefit from the road construction. The human use of roads facilitates the spread of exotic plants and animals, further reducing the quality of habitat for native flora and fauna (Bennett 1991). In the past, species that depend on large trees, snags or logs, particularly cavity-using birds and mammals are vulnerable to increased harvest of these structures, which was facilitated by motorized access.

Roads and their adjacent environment qualify as a distinct habitat and have various species, population, and landscape-scale effects (Baker and Knight 2000, Dawson 1991, van der Zande et al. 1980). However, this finding may not apply to forest roads with only narrow cuts and fills on either side, which occurs on most roads on the Mendocino National Forest. The similarity between forest roads and transmission-line rights-of-ways may be important in assessing the contribution of roads to habitat. Studies have shown that wide transmission-line corridors support grassland bird communities of species not found in the forest, and narrow corridors produce the least change from forest bird communities (Anderson et al. 1977).

Table 1 shows the evaluation of the key routes used to determine potential for fragmentation. However while the ratings below are suggestive, it is not wise to try and determine extent of effects on a species. Habitat fragmentation of this kind is more properly evaluated at the watershed or project scale, where very detailed information may be gathered pertaining to road physical characteristics and in determining how much of the habitat is really lost. The table also shows that the Late-successional Reserves are more affected by habitat fragmentation than areas outside of them.

Table A3.4- 1 - Key Routes and Fragmentation			
Map Label	**Route**	**Issue Description[1]**	**Score[2]**
M22	M22 from Forest bdy to jct w/M2	• Most of M2 • .50 miles to junction of M2 – M4G	L H
M2	M2	• LSR 309 – M4G, M6G, M3G Outside of LSR – M4G and M4P (keep H rating for all of the road)	H
23N39	23N39 Espee Ridge tie through	• C4X and M3G	M
24N01	East 24N01 from jct w/M2 to Kingsley Glade	• LSR 309 – M6G	H
M4	M4 from Forest bdy to jct w/M2 near Government Flat	• LSR 309 – M4G, M6G, M3G, M4P • Outside LSR - low	H L
M1b	M1 from Eel River Station to jct w/M21	• C4X, M4P and very small part of M4G. Give the whole road a M rating	M
24N21b	24N21 from jct w/Hwy 162 to jct w/24N13 near Blands Cove	• Small amount of M4G	M

[1] A GIS map that shows roads and vegetation strata was used to develop the table. Since the wildlife species that are most affected by habitat fragmentation are species that depend on mature or old growth stands, the rating system is based on their habitat requirements.

[2] Rating system (for all level of analysis – forest, watershed, or project)

Low - All closed or impassible roads; or all roads within non-commercial conifer types that do not have the potential to produce late-successional old growth (LSOG) (e.g. grass, chaparral, gray pine, live oak); or roads passing through commercial conifer stands with 1S/P /G, 2S/P/G, 3S, or 4S size class/canopy closures or plantations.

Medium - All roads pass through 4P stands; or roads outside of Late-successional Reserves (LSR) passing through C4X stands.

High – All roads passing through 3G, 4G or 6G; or stands within the LSR passing through C4X.

Table A3.4- 1 - Key Routes and Fragmentation			
Map Label	**Route**	**Issue Description[1]**	**Score[2]**
FH7	FH7	• Red fir zone by Snow Basin/Black Butte Mt. Road – R4X • Surveyor Camp – C4X (call the area from Snow Basin to Surveyor Camp a "M" and the rest of the road low) • Rest of the road is low	H M L
M1c	M1 from Eel River to jct w/M61	• LSR 310 – M3G, C4X and M4P (only a little of C4X – keep a M rating for LSR) • Outside of LSR - low	H L
M61	M61	• M4P	M
CR311	Slapjack	• No concern	L
M3b	M3 from jct w/ top of Slapjack to jct w/M6	• No concern (private land – already logged)	L
M3c	M3 from jct w/M6 to Ivory Mill	• M4P	
M6	M6	• Only one small patch habitat – keep rating of low	L
M3d	M3 from Ivory Mill Saddle to jct w/Crockett Trailhead spur.	• LSR 311 – M4G and M3G • Outside LSR – C4X, M3G (very little M3G)	H M
M1e	M1 from Cabbage Patch to Soda Creek	• No concern	L
CR301	Lake CR301 from Soda Creek to jct with Mendocino CR 240B	• Small patch of M4P – keep low rating for the whole road	L
CR240B	Mendocino CR240B from jct w/Lake CR301 to jct w/M8	• No concern	L

Table A3.4- 1 - Key Routes and Fragmentation			
Map Label	**Route**	**Issue Description[1]**	**Score[2]**
M1f	M1 from Soda Creek to Forest boundary (Lake CR301) Access from Upper Lake to Pillsbury Basin	• LSR 312 – M6G and C4X • Outside LSR – M4P at junction with M10	H M
M10	M10	• LSR 313 – M6G, M4G, and C2X • Outside LSR – M4P at junction with M1	H M
17N02	17N02	• LSR 313 – M6G and M4G	H
16N30	16N30 form Sam Alley Ridge to near High Glade	• No concern	L
16N01	16N01	• LSR 313 – M6G • Outside of LSR	H L
M5a	M5 from jct w/M10 to jct w/Little Stony Rd	• LSR 313 – M3G and M6G • Outside of LSR – M3G (very little), C4X, M4P	H M
M5b	M5 from jct w/ Little Stony Rd to Pacific Ridge Station	• Outside LSR – C4X	M
M12	M12 (CR303 – Lake)	• No concern	L

Roads, past timber harvests, and wildfires are some of the major causes of forest habitat fragmentation on the Mendocino National Forest. However, the forest is also naturally fragmented due natural vegetation patterns. Most of our south slopes are dry and brushy. There are also large areas of private land that has been harvested that affect the fragmentation of habitat within the Forest boundary.

Roads can act as a barrier to terrestrial species movement. The effectiveness of the barrier is a result of road width, traffic density (Gucinski et al. 2001), and the mobility those species. Roads become a more effective barrier as road width and traffic density increase and species mobility decreases. In some areas, however, roads can act as a dispersal route. It is not unusual in the areas of dense brush or understory to have wildlife use roads to move from one area to another. This has been noted by both people traveling on the roads and by visually seeing the amount of wildlife tracks occurring on certain roads and trails. Due to the low level of traffic density on most of the roads on the forest except for limited time periods, such as hunting season, and the width of most of our roads these impacts do not seem to be an issue at this time on the forest. It should also be noted that since most of the roads on the forest are not paved or improved that vehicles usually couldn't be driven at a high speed over most of the Forest.

Large numbers of animals are killed annually on roads. Studies show that the number of collisions between animals and vehicles is directly related to the position of the nearest resting and feeding sites (Gucinski et al 2001). Because most forest roads are not designed for high-speed travel, and the speed of the traffic is directly related to the rate of mortality, direct mortality on forest roads is not usually an important consideration for large mammals (Lyon 1983). An exception is forest carnivores, which are especially vulnerable to road mortality because they have large home ranges that often include road crossings (Baker and Knight 2000). Forest roads pose a greater hazard to small, slowly moving, migratory animals, such as amphibians, making them highly vulnerable as they cross even narrow forest roads. Nearly all species of reptiles use roads for cooling and heating, so many of them are killed by vehicles (Gucinski et al 2001). As noted above, due to road conditions on the Forest, vehicles usually cannot drive a high rate of speed on the Forest. This will lessen the impacts described in this paragraph.

The spatial distribution and arrangement of the road system over the landscape is an important and useful tool for understanding and evaluating the Forest road system. Road density, usually expressed in terms of miles of road per square mile of landscape, can be an important indicator of such things as habitat fragmentation, the potential for wildlife disturbance, visual quality, recreation opportunities, the cumulative potential for erosion and sedimentation from road surfaces, and cumulative increases in peak flow due to runoff from road surfaces and ditches. Road density information may be useful, but is also difficult to interpret. Separating the effects of roads from other landscape and ecological modifications that result from changes in land use that roads enable is often impossible. Also, some effects are more associated with road use rather than the mere physical presence of roads. Confining the analysis to open roads may account for some of this difference, but road use characteristics may change seasonally or periodically. Road density information at the forest scale should be regarded as interesting and useful in determine what areas should reviewed further. Road densities are more properly evaluated at the watershed or project scale, where very detailed information may be gathered pertaining to road physical characteristics and use patterns. In order to maximize the validity of interpretations, the information gathered must be tailored very closely to the specific question or issue being addressed.

Table 2 shows the rating of road density by watershed and provides an indicator for which watershed would have a higher priority for reviewing road density issues. The rating is not designed to show potential effects to wildlife other than to provide a method to separate watersheds by priority for further review.
When reviewing road densities at the watershed or project level the rating system can be designed toward the species of concern. It should be noted although the Land Resource and Management Plan habitat capability models for fisher and marten contain values for road densities, studies have not been done to determine at what level road densities become an issue for marten and fishers.

TABLE A3.4- 2 - Road Density and Effect to Wildlife			
Watershed Name	**Issue Description** **All Roads**	**Open Roads ONLY**	**Score**
Bear Creek	• Low	Low	L
Black Butte River	• High	Medium (lots of private land)	H
Briscoe Creek	• High	High (lots of private land)	**H**
Elder Creek	• High	High (lots of private land)	**H**
Elk Creek	• High	Medium (lots of private land)	H
Grindstone Creek	• High	High (lots of area not affected)	**H**
Lakeport	• Low	Low	L
Little Stony Creek	• Medium (1 area High)	Medium (scatter private land)	M
Middle Fk Stony Cr	• Medium (Both maps High around Letts and Fouts area)	Medium	M
North Fk Cache Creek	Medium (2 areas High) (scatter private land)	Medium (lots of area not affected)	M
North Fk Stony Creek	• High	Medium (1 area High)	H
North Fork Eel River	• Low	Low	L
Red Bank Creek	• Low	Low	L
Rice Fork	• High (scatter private land)	Medium (2 areas High)	H
S Fk Cottonwood Cr	• Low	Low	L
Soda Creek	• High (scatter private land)	Medium (1 area High)	H
Thomes Creek	• High (lots of private land)	High	**H**

TABLE A3.4- 2 - Road Density and Effect to Wildlife			
Watershed Name	**Issue Description** **All Roads**	**Open Roads ONLY**	**Score**
Tomki Creek	• Low	Low	L
Upper Lake	• Medium (2 areas High) (scatter private land)	Low (2 areas medium)	M
Upper Main Eel River	• High	Medium (1 area high; lots of area low or not affected)	H
Upper Middle Fork Eel	• High	Medium (lots of area Low)	H
Williams-Thatcher	• Medium (high)	Medium (lots of area unaffected)	M

A GIS map was created using a moving grid with a 1-mile radius. Two maps where created one with all roads that are currently routed on the Forest and the other map only showed maintenance level 2 and higher roads. Private owned roads were **not** included in either map. The highest rating between the two was used for the score. The rating system to be used for all analysis levels follows:

Low – 0 - 3 miles of roads/mile

Medium – 3 - 6 miles of roads/mile

High – 6 - 10 miles of roads/mile

Many species are sensitive to human presence, which are often facilitated by road access. Harassment can lead to reductions in productivity, increases in energy expenditures, or displacements in population's distribution or habitat use (Bennett 1991, Mader 1984). Species that utilize caves, mines, rock crevices, and cliff faces are vulnerable to disturbance and displacement caused by human activities. Disturbance created by activities such as caving, mine exploration, and rock climbing could reduce fitness of bats that roost in these sites (Gucinski et al. 2001). Other species occur on the Forest and are susceptible to disturbance or displacement by these activities, such as the prairie falcon, peregrine falcon and golden eagle. The level of disturbance would have to be determined at either a watershed or project level. The determination would have to be based on species and local conditions.

Roads provide access for illegal activities affecting habitat, such as arson, development of drug facilities (marijuana gardens and methamphetamine labs) and unpermitted plant collection. These activities are often in remote areas and can escape detection for long periods of time. They can have serious adverse effects on small, localized populations.

Roads assist hunter movements, leading to increased human presence during hunting season and are used by poachers to access areas for illegal hunting. This could mean overharvesting of certain species or removal of non-game species. There is no documentation to show how illegal activities have affect species on the Forest.

Access provided by the Forest road network can facilitate habitat protection and improvement projects. Habitat improvement projects that involve the use of equipment and/or personnel can be accessed and completed safer and cheaper with road access. For example, dense understory stands can be thinned by using mechanized methods or prescribed fire at a reduced cost, in less time and more safely than in unroaded areas. Roads can help protect forest habitats by providing access for initial attack on wildfires, acting as firelines, and providing safe deployment areas for fire fighting personnel.

In summary, most native terrestrial species located on the Forest could be adversely affected by road-associated factors that can degrade habitats or increase mortality. In landscapes with moderate to high road density, habitats are likely underused by many species that are negatively affect by road-associated factors. For this forest, this impact could vary in each watershed depending on intensity and duration of use.

<u>Botanical Species: Rare Plants</u>

Many of the same effects described for terrestrial wildlife species apply to native plants. Roads often intersect unique habitats. These include but are not limited to areas with serpentine soils, rocky outcrops, dry meadows, springs, seeps, and transient wetlands that are often isolated and favor the development of unique plant associations. As roads were built through these habitats, fill was often placed on top of existing habitat. The resulting changes in drainage patterns can change surface soil composition and allow the introduction of noxious weeds (discussed in detail later). These effects may cumulatively result in significant alteration of existing rare plant communities. Road maintenance has the potential of adversely affecting known populations of sensitive plants that are located adjacent to the road or within the roadbed. Road access may also facilitate plant collecting, which may be detrimental to small isolated plant populations like dimorphic snapdragon, adobe lily and woolly star.

Road maintenance soil stabilization work sometimes involves the use of fertilizer and herb or forb seeds. In serpentine soils the use of fertilizer increases the chance for growth of introduced weedy species that may outcompete sensitive endemic species at the site. The use of introduced graminoid species also increases the chance for displacement or replacement of native flora, including sensitive species.

Since the Forest Service does not manage all roads within the forest boundary, there is potential for impacts to populations due to road maintenance conducted by private or county road managers. There have been cases on the forest where the county roads maintenance has affected populations of Forest Service sensitive species located along county roads. An example would be the adobe lily population along the Little Stony road. This population was reduced due to blading done during road grading.

Dust created during road travel and maintenance activities that occurs during the months when sensitive plants are flowering may reduce the ability of insect-pollinated flowers to be pollinated. This would reduce the amount of fertile seed that is produced. For annual species like woolly star and dimorphic snapdragon this would reduce the amount of seed that is added to the soil seed bank and thereby reduce their potential for maintaining long term viability.   Unless the road maintenance or road use activities are extremely unusual, this is not usually a situation that is critical, since most annual species do not germinate all the seeds in the soil seed bank in any given year.   Repeated years of extreme dust production may be detrimental, but an occasional year is not likely to be critical for these annual plant seedbanks.

Table A3.4- 3 - Key Routes and Sensitive Plant Issues			
Map Label	**Route**	**Issue Description**	**Score**
M22	M22 from Forest bdy to jct w/M2	• **M22** passes through serpentine soils on lower Valentine Ridge that may have endemic species occurrences that could be affected by road maintenance and work	L
24N01	East 24N01 from jct w/M2 to Kingsley Glade	• The northern portion of **24N21** passes beside two known water howellia (*Howellia aquatilis*) occurrences and potential habitat that affect the hydrology of several occurrences of clustered lady-slipper orchid (*Cypripedium fasciculatum*) in the area between Blands Cove and Pothole Creek**.** Proposed Roadwork above the annual grading that may affect the hydrology or drainage patterns from **24N21** should be closely evaluated to determine if it would affect these species.	H
M4	M4 from Forest bdy to jct w/M2 near Government Flat	• There is a Tripod Buckwheat (*Eriogonum tripodum*) occurrence 4.3 miles up **M4** from Salt Creek Conservation Camp on the south edge of **M4**. • A Snow Mountain Milkweed (*Ascelpias solanoana*) occurrence recently was bladed during roadwork on **M4**. It was growing on a steep, schist-cobble slope on the south edge of **M4**, 0.25 mile below the green gate to the Devil's Basin RNA, which also is 1.1 mile below the 23N026 junction with 23N02 and 3.0 mile below Horse Trough Creek junction with **M4**. Does not appear to be in an area that would need road widening, since it was growing adjacent a very wide section of **M4**.	L
M1b	M1 from Eel River Station to jct w/M21	• Protecting Sensitive Plant Occurrences of Stebbin's Lewisia (*Lewisia stebbinsii*, **LEST**, CNPS List 1B, RED code 3-2-3) from changes in hydrologic flows, inadvertent disturbance and from the introduction of noxious weeds during road maintenance work is one of the most critical botanical road issue on the MNF. Occurrences are located on both sides of 1N02 (**M1b**) at Buzzard Roost, [approximately 1.2 miles SE of Grizzly Flat, in the NE ¼ of sec 16, T21N, R10W at 5,640' elevation] and east of Bald Mtn. along both sides of **M61** (20N02**)** beginning at Hell's ½ Acre (T20N, R10W, section 3 and 10) and continuing east to the junction of 20N02 with the jeep road in the center of the bottom of section 12 at 5,882' elevation. •	H
M61	M61	• See above note	H

Table A3.4- 3 - Key Routes and Sensitive Plant Issues			
Map Label	**Route**	**Issue Description**	**Score**
M3b	M3 from jct w/ top of Slapjack to jct w/M6	• Three SENSITIVE or rare Serpentine Endemic Plant species are known to grow along Road **M3b** in T17N, R9W: Hesperolinon *drymarioides* and H*. adenophyllum* (both CNPS List 1B species with RED codes of 3-2-3 and 2-2-3) grow in chaparral openings adjacent to the road (together in the NE ¼ of section 9 and HEAD alone in the NW ¼ of section 15); *Astragalus clevelandii* (CNPS List 4 with RED code 1-1-3) grows in a serpentine rivulet (in the center of section 4) that flows at least into early summer. Two other serpentine-endemic species, *Helianthus exilis* (CNPS List 4, RED code 1-2-3) and *Senecio clevelandii* (CNPS List 4, RED code 1-1-3), also grow in this area.	M
M1e	M1 from Cabbage Patch to Soda Creek	• Two rare lichens (*Sulcaria badia* and *Bryoria tortuosa*) have recently been found in the Soda Creek Area. Road widening that may include removal of larger trees adjacent to **M1e** should be surveyed before their removal.	L

Noxious Species

There is overwhelming evidence that roads contribute to the spread of weed species by providing dispersal corridors and mechanisms for dispersal. As a result the Mendocino N.F. faces serious threats from a number of invasive plant species and the pathogen responsible for Sudden Oak Death (Phytophthora ramorum).

It is important to first establish that there is a connection between roads and noxious plant infestations. Numerous studies document this link. In South American temperate forests, up to 33% of plant species in areas along roads were exotic invaders, whereas in pristine areas, away from trails, no invaders were found (Bicon, et al. 1987). In Australia, road verges had a greater diversity of exotic (invader) species than other areas (Cale and Hobbs 1992). In a study of alien invasive plants in the open country between towns in Ireland, the alien plants were almost always confined to the edges of roads (Reynolds 1992). Logging roads have accelerated the spread of gorse in British Columbia (Clements et al. 2001). Movement along roads is a major method for plant dispersal in the Great Lakes area (Mills et al. 1993). Gary Mcfarlane (2000) sums it up: “Roads have a tremendous catalyzing effect on weeds. Nearly without fail, where there are roads you will find weeds.”

However, the harmful effects of noxious weeds are not limited to a narrow corridor of roadside shoulder; roads also provide weeds with access to undisturbed, adjacent natural areas. For the Forest Service, a government entity charged with protecting native flora and habitat, the loss of native diversity due to noxious weeds is a serious problem indeed.

A major concern of biologists working in wildlands is the loss of diversity caused by invasive species, due largely to migrations away from roadsides and into undisturbed natural areas (Hobbs and Humphries 1996). Though noxious weeds prefer disturbed areas, their presence is not confined to roadsides, agricultural lands or similar places once they get a foothold. Research in Central Europe has shown that roads can be more than just discreet corridors of infestation, they also provide invasive species a staging point prior to entry into adjacent, undisturbed native habitats (Kopecky 1988). In Ireland, previously weed-free bogs hosting a relatively pure native flora have been invaded by up to seventy-seven new species emanating from road corridors (Curran and MacNaeidhe 1987). In the U.S., residents of the Northern Rockies have seen spotted knapweed spread from the disturbed agricultural areas to wildlands, by way of a road matrix. A study of grasslands in Glacier National Park, using transects perpendicular to primary and secondary roads, suggests that alien species are successfully invading grasslands from roadside areas (Tyser et al. 1992). On the Mendocino N.F., weed occurrences migrating from the road matrix into neighboring drainages and hillsides is a serious concern. A 40 acre outbreak of Scotch broom on Sumner Ridge began at a road terminus and has spread over 300 feet, nearly to French Creek.

When put into context, the problems of native flora and habitat loss are sobering. According to a 1998 survey of 400 biologists commissioned by New York's American Museum of Natural History, biodiversity loss was considered a more serious environmental problem than global warming, pollution, or depletion of the ozone layer. In addition, 42% of the nation's threatened or endangered species, both animals and plants, are at risk primarily because of competition with nonnative species, according to a 1999 Cornell University report (Deneen 2002). Mike Kelly, a founder of the California Exotic Pest Plant Council, cites a BLM statistic showing that the federal agency is losing 4,000 acres a day to invasive plants. "After [land] development, the second biggest threat to our biodiversity is invasive plants," Kelly said (The San Diego Channel 2002). Because development is not a major cause of altered landscapes in the Mendocino N.F., it is quite likely that invasive species are the most significant unmanaged cause of native habitat loss on the forest.

However, losses are not only counted in lost acres of native habitat - there are economic repercussions. Noxious weeds are an expensive liability to land owners and managers. When weeds spread, they displace native plant species that provide food and habitat for wildlife, people and livestock. Weeds cost us money by reducing the land's natural and agricultural productivity; they cause increased maintenance costs and reduce the usefulness of recreation areas as well. The following are some examples, at different landscape scales, of the cost of weed infestation. The San Diego City Park and Recreation Department is removing Tamarisk at a cost of $10,000 to $25,000 an acre (The San Diego Channel 2002). The negative effects of broom conservatively amount to more than $11 million US dollars in western North America (Isaacson 2000). Estimates place the economic impact of fighting one species, leafy spurge, at over $100 million in the Great Plains in 1990 (BLM 2002).

There are several factors contributing to the establishment and dispersal of noxious weeds along roads:

1. Road shoulders provide prime habitat for noxious weeds.
2. Roads attract vehicles, the vectors that introduce and spread noxious weed seeds.
3. Road maintenance can spread and enlarge noxious weed banks, ensuring weed seed sources for decades to come.

For the most part, noxious plants are Old-World species that have evolved and adapted over thousands of years in close association with agriculture based human landscapes; specifically, with regimes of soil disturbance such as cultivation, and road construction. What we call noxious plants, or weeds are the plants uniquely adapted to revegetate severely disturbed soils. Although aspects of the flora native to northern California also evolved with disturbance, such as flooding, wild ungulate grazing, and wildfire, it was of a different nature, and did not result in annual disturbance that included deep turning of soil. Because modern road construction and maintenance causes drastic soil disturbance, the favorably adapted Eurasian weeds easily displace native plants along road corridors. As Cousens and Mortimer said (1995): “Weeds move along roads because they provide the right habitat for colonization. Weeds are usually early seral species, pioneers in the classic theory of ecological succession.”

A study of the Hastings Reservation in central coastal California revealed that no introduced species were present in chaparral, coastal sage or rock outcrops and very few (4% of the total species number) in the mixed evergreen woodland. The highest percentage of introduced species (40%) is found in disturbed areas, such as roadsides and around buildings. This reinforces anecdotal evidence that humans are the main cause of intentional or accidental dispersal into this reservation and that the most likely habitats of first establishment are the disturbed areas around houses and roads. Vegetation types with less frequent disturbance, such as chaparral, coastal sage and mixed evergreen oak woodlands are not, or much less, invasible (Knops 1995).

However, the disturbance caused by a road matrix may affect habitat beyond the immediate road corridor. Roads can alter the hydrology, exposure and soil profile of an area, thus altering the microclimate directly surrounding them. A study in the Northeastern U.S. found the microclimate around roads to be different than the lands adjacent to them (Brothers 1992).

Weed movement through the road matrix occurs by a variety of vectors including but not limited to automobiles, motorcycles, off-road vehicles, bicycles, horses (and hay), hikers, their pets, and even wildlife. All use forest service road systems, and can act as unintentional vectors of noxious weed spread.
When a vehicle is driven through an area infested by weeds, weed seeds may become lodged between the tire treads, in the coils of a winch, behind the license plate, or in cracks and crevices on the underside of the vehicle. Seeds may travel hundreds of miles before dropping off into areas that had no weed infestation.

A study in Northern Australia inspected 304 tourist vehicles to see if these vehicles were in fact vectors of spread of weed seeds (Lonsdale 1994). Careful sweeping and vacuuming of car exteriors, engine interiors, and mud on tires revealed that the majority (96%) of all cars carried one or no seeds. However, those weed species that were found on tourist cars occurred at 3 times as many sites in the park as those that were not, suggesting that movement of seeds by tourist cars contributes to weed infestations, in spite of the low number of seeds found on vehicles. In another study by Lonsdale (1990) in Kakadu Naitonal Park, in Australia, 220 additional tourist vehicles were inspected for weed seeds using methods similar to those described above. This study found a higher incidence of seed infested vehicles: 70% of all cars searched carried 1-10 seeds per car.

Lonsdale concluded that, in view of the low density of weed seeds entering the park in tourist vehicles, resources are best spent on detecting and eradication existing weed infestations, rather then on attempting to prevent this form of seed movement.

Not only does road construction allow noxious weeds a foothold, road maintenance promotes a regime of regular, reoccurring disturbance that insures the creation of deep and well populated weed seed-banks that can cause an exotic flora to persist for years after disturbance has ceased. A study in southern California shrubland monitored severe anthropomorphic disturbances: construction, heavy equipment, heavy vehicle, landfill operations, soil excavation, and tillage. These disturbances led to the conversion of indigenous shrublands to exotic annual communities with low native species richness. As expected, nearly 60% of the cover on disturbed sites consisted of exotic annual species, while undisturbed sites were primarily covered by native shrub species (68%). Shockingly, the cover of native species remained low on disturbed sites even *71 years* after initial exotic disturbance ceased (Stylinski 1999). In a study at the H.J. Andrews Experimental Forest in Oregon, roads apparently served multiple functions that enhanced exotic species invasion in this landscape because they act as corridors or agents for dispersal, provide suitable habitat and contain reservoirs of propagules for future episodes of invasion. Remarkably, even roads with no traffic for 20-40 years had a dominant population of exotic species (Parendes 2000). When noxious weeds remain a significant part of an undisturbed plant community for 20,40, even 71 years after a cessation of disturbance, the weed seed bank must have played a significant role in the population's longevity.

Native soils with existing seed banks may be somewhat resistant to invasion - even if disturbed - where native soils are present. This is an important fact to note for our Forest road builders. In a study of roadsides in Florida (Greenberg 1997) researchers found that in general, revegetation after disturbance on roadsides and clearcuts composed of native soil rather than exotic fill, had higher characteristic native plants, and lower weedy plant cover. This suggests that Florida's native xeric scrub may be somewhat resistant to invasion when native soils are present, even if disturbed! What caused these results? For one, radically different exotic fill types: when clay was brought in as fill for an originally sandy area, hydrologic regime was drastically changed, as was soil chemistry through pH. Nutrients and pH differed also drastically for an imported roadbed of limerock. And probably all the exotic road bed soil carried non-native propogules and seed. If road maintenance on the Mendocino N.F. uses same-site soil during projects weed occurrence may be reduced, especially if the topsoil of native-site fill is scraped off the top of the excavation and replaced at the conclusion of the work. Saving the native soil and seed bank is invaluable to preserving native habitat and reducing weed occurrence.

Sudden Oak Death, a fungal disease spread by *Phytophthora ramorum*, is another exotic species that poses a serious threat to the flora of the Mendocino N.F. *Phytophthora ramorum* has been documented as infesting arrowood (*Viburnum x bodnantense*), California bay laurel (*Umbellularia californica*), California buckeye (*Aesculus californica*), California coffeeberry (*Rhamnus californica*), California honeysuckle (*Lonicera hispidula*), coast live oak (*Quercus agrifolia)*, huckleberry (*Vaccinium ovatum*), madrone (*Arbutus menzeisii*), manzanita (*Arctostaphylos spp*.), rhododendron (*Rhododendron spp*., including azalea), Shreve's oak (*Quercus parvula var. shrevei*), tanoak (*Lithocarpus densiflorus*), and Toyon (*Heteromeles arbutifolia*) – all species that occur in the Mendocino N.F.(USDA 2002). Additionally, the most recent tests in the field have revealed SOD infection of coastal redwood saplings and Douglas fir saplings (Birmingham pers. comm. 2002)

It is unclear how *P. ramorum* spreads, although available research suggests it is spread by water, soil, and infected plant material. It may also be spread by airborne movement. A very likely means of spread to the Mendocino N.F. is in soil inadvertently transported by any of the vectors that use roads: automobiles, motorcycles, off-road vehicles, bicycles, horses (and hay), hikers, their pets, and even wildlife. In a State Park infested with SOD, tests were performed to see if microbes were in fact attached to vectors of spread, and they were found on the shoes of 90% of hikers leaving the park. Spores were also found on bicycle tires. UC pathologist David Rizzo (NPR-ATC 2002) says visitors can help contain the spread of the disease. Many state parks and other parks are posting signs that suggest washing of boots and tires.

Phytophthora lateralis (PL), the fungal pathogen affecting Port Orford Cedar (POC) is mainly, but not exclusively found in coastal areas. Measures taken to control the spread of POC may give us insight into how to prevent, or resist the contagion causing SOD. Both pathogens are fungal, and both are the same generic taxa. Frand Betlejewski (2002), POC Program Manager for the Biscuit Fire, offers this typical scenario for the spread of PL (and by association, SOD):

> "PL is spread via water or soil. A typical spread scenario for PL involves infested soil being transported into an uninfested area on a vehicle or piece of equipment or infested water being transported in a water delivery. The infested soil falls off of the vehicle or spores are delivered via water and the pathogen first infects nearby hosts then is washed downhill in surface water infecting additional hosts, especially along the drainages and creeks where infested water is channeled. The risk of disease transport is high if a vehicle carrying soil or water comes from an infested area and travels to an uninfested area."

The vectors of spread of the fungal pathogen causing disease in POC are very likely the vectors of spread we should be concerned with should SOD threaten the Mendocino N.F. The POC program set up these basic parameters for the safe movement of vehicles through areas infested, or suspected of infestation:

1. Vehicles and equipment are thoroughly cleaned to remove adhering soil or plant debris that may contain PL before moving them into uninfested areas and conversely, washing them before leaving infested areas of the forest.

2. Vehicles that carry soil infested by PL are known to be by far the most important long-distance carriers of the pathogen. Vehicle washing should take place as close as possible to infested sites.

An evaluation to test the effectiveness of a vehicle washing treatment was conducted by the Southwest Oregon Forest Insect and Disease Service Center in June, 1999. The results indicated that there were large reductions of inoculums on the vehicles following washing (Betlejewski 2002).

The USDA/APHIS (2002) identifies the following unprocessed wood and wood products as presenting a significant risk of spreading SOD: firewood, logs, lumber, wreaths, garlands, nursery stock, and greenery of the susceptible species cited above. Consequently, the USDA has imposed a quarantine that regulates and restricts the interstate movement of these articles. Of more immediate significance to the Mendocino National Forest is the restriction the state of California (California Department of Food and Agriculture) has placed on movement of regulated and restricted articles out of infested counties. With these restrictions in mind the Covelo Ranger District - located partly in the quarantined Mendocino County, is issuing firewood gathering permits for dead and down conifer species only, and removal of hardwood is prohibited.

The disease was first identified on tanoak in the bay area in 1995. Since then it has spread to 10 California counties: Marin, Alameda, Mendocino, Monterey, Napa, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma; and portions of Curry county in Oregon. Mendocino County is infested and falls partly within the boundaries of the Mendocino N.F., although no instance of SOD has been documented within the forest itself. Additionally, Placer county, CA, located in the Sierra Nevada foothills, is now under an “unofficial but pending” quarantine (USDA 2002). The disease was originally thought to be restricted to a coastal habitat; however, the recent discovery of the organism in the Plumas County has challenged this belief, and potentially puts the Mendocino N.F. directly in the path of a spread of S.O.D. to the interior of the state.

Oregon authorities are concerned enough about soil as a vector that they have asked hikers and bikers to clean their boots and tires when leaving infested areas (Berkeleyen 2002). Additional quarantines may lead to close coordination with state and federal authorities.

If SOD occurs in the forest, consequences to all plant communities containing oaks and other host species could be catastrophic. Since 1995 over 100,000 adult oak trees have been lost in infested areas (Taugher 2002).

Rating Criteria for Invasive and Noxious Weeds

The ratings in Tables A3.4- 4 & 5 are based upon the following criteria:

<u>Low:</u> these weeds tend to be ubiquitous, but restricted to, most road corridors; and are consequently a problem at a watershed to forest scale.

<u>Moderate:</u> these weeds tend to be ubiquitous in the forest and commonly found along most roads; however, they are of greater concern because they are threatening to invade a sensitive ecological area such as a wetland, sensitive plant habitat, or wilderness area.

<u>High:</u> these weeds are of the greatest concern. They have recently infested the forest, and are ecologically aggressive; if they are not eradicated quickly we risk serious ecological consequences. These weeds are, by definition, fought at a project, or point source scale.

Table A3.4- 4 shows the evaluation of the key routes used to determine potential risk of noxious weed infestation; however, many of the infestations are point sources and as of now should only reflect the assigned risk for that immediate section of road (50 meter radius from point to cover seed dispersal). Key routes that present no risk of weed infestation are not shown on table.

Table A3.4- 4 - Key Routes: Invasive and Noxious Weed Issues

Map Label	Route	Issue Description	Score
M3b	M3 from junction w/ Top of Slapjack to jct. w/M6.	• During road maintenance work avoid introducing Noxious weeds into the prime Native Perennial Grass Seed Source Area (for *Danthonia californica*, etc.) along Road **M3b** (18N04) from Bear Creek up to Rice Creek in section 15 and 9 of T17N, R9W;	M
M22	M22 from Forest bdy to	•Medium concern that this road could act as a corridor for the spread of weeds – particularly YST – into adjacent wilderness; based on survey.	M

Table A3.4- 4 - Key Routes: Invasive and Noxious Weed Issues			
Map Label	**Route**	**Issue Description**	**Score**
	jct w/M2		
M2	M2	•High concern for outbreak of Canadian Thistle at Thomes Creek adjacent to M2; based on province weed survey. •Medium concern that this road could act as a corridor for the spread of weeds – particularly YST – into adjacent wilderness; based on survey.	H
24N21b	24N21 from jct w/Hwy 162 to jct w/24N13 near Blands Cove	•Medium concern that this road could act as a corridor for the spread of weeds – particularly YST – into adjacent wilderness; based on survey. Additionally, YST *has entered* the wilderness along this route at Hoxie Crossing. •Medium concern that this road *has acted* as a corridor for the spread of Medusa Head Grass at Foster Glade *within the wilderness*; based on survey. •High concern that this road *has acted* as a corridor for the spread of weeds Canadian Thistle at George's Valley *within wilderness*; based on survey.	M M
FH7	FH7	•High concern that this road is a corridor for the spread of Broom, centering on the area from Alder Springs east to Grindstone Overview. Based on survey and eradication. •Balance of road of no concern.	H
M1c	M1 from Eel River to jct w/M61	•No concern.	L
M61	M61	•High concern that this road is a corridor for the spread goat grass which is found in two distinct populations near Tar Flat Station, north and south of M61. Based on survey and some eradication.	H
M6	M6	•Low concern that this road is a corridor for the spread of medusa head grass found at Bloody rock. Based on survey.	L
M3d	M3 from Ivory Mill	•Medium concern that this road could act as a corridor for the spread of weeds – particularly YST – into adjacent wilderness; but only at the southern extent of the	M

Table A3.4- 4 - Key Routes: Invasive and Noxious Weed Issues			
Map Label	**Route**	**Issue Description**	**Score**
	Saddle to jct w/Crockett Trailhead spur.	road where it is adjacent to wilderness; based on survey.	
M1e	M1 from Cabbage Patch to Soda Creek	•High concern that this road is a corridor for the spread of Broom, centering on the area of Pogie Point, but this whole road is at risk of Broom Infestation; based on survey and eradication.	H
M1f	M1 from Soda Creek to Forest boundary (Lake CR301) Access from Upper Lake to Pillsbury Basin	•High concern that this road is a corridor for the spread of Broom, centering on the intersection of the road with the Middle Creek; based on survey and eradication.	H
M10	M10	•Medium concern that this road could act as a corridor for the spread of weeds – particularly YST – into adjacent wilderness; based on survey.	M
17N02	17N02	•High concern that this road is a corridor for the spread of Broom, centering on the intersection with M10, but this whole road is at risk of Broom Infestation; based on survey and eradication.	H
16N01	16N01	•High concern that this road is a corridor for the spread of Broom where it intersects with secondary road 16N35, where there is a 30 acre Broom outbreak; based on survey and eradication.	H

Table A3.4- 5 shows the potential risk of noxious weed infestation at a watershed scale; however, many of the infestations are point sources and are not likely to spread quickly throughout the watershed. In these cases the watershed was given a moderate overall score.

Table A3.4- 5 – Invasive and Noxious Weed

Watershed Name	Issue Description	Score
Bear Creek	• Low	L
Black Butte River	• Moderate: goat grass north of Tar Flat.	M
Briscoe Creek	• Moderate: Broom near F7 south of Grindstone Overview.	M
Elder Creek	• Low	L
Elk Creek	• High: two Goat Grass sites.	H
Grindstone Creek	• Low	L
Lakeport	• Low	L
Little Stony Creek	• Low	L
Middle Fk Stony Cr	• High: three Broom outbreaks.	H
North Fk Cache Creek	• Low	L
North Fk Stony Creek	• Low	L
North Fork Eel River	• Low	L
Red Bank Creek	• Low	L
Rice Fork	• Moderate: 30 acre Broom outbreak an16N35 terminus.	M
S Fk Cottonwood Cr	• Low	L
Soda Creek	• Low	L
Thomes Creek	• Moderate: Canada thistle at Thomes Creek.	M
Tomki Creek	• Low	L

Table A3.4- 5 – Invasive and Noxious Weed		
Watershed Name	**Issue Description**	**Score**
Upper Lake	• Moderate: Broom is found at Middle Creek Camp.	M
Upper Main Eel River	• Moderate: Broom site north of Pogie Point).	M
Upper Middle Fork Eel	• High	H
Williams-Thatcher	• Low	L

Scale, Indicators and Data Source

Key Question: What are the direct effects of the road system on terrestrial species habitat? **Scale:** Forest, Watershed, Project **RAP question numbers**: EF1, EF5, TW1
Indicators: Habitat fragmentation created by roads and associated activities such as timber harvest, road use intensity and road density. Plant populations located within the influence of road maintenance.
Data Source: Data on species susceptibility to disturbance, catalog of species in the area and map known locations and their associated habitat.

For forest level: Review road density maps and develop data on species susceptibility to disturbance. Determine plant species located adjacent to key routes.
For Watershed and Project Level: Develop road density and intensity of use data. Map species and their associated habitat. Use this data to determine effects to the area for existing road system.

Key Question: How does the road system facilitate legal and illegal human activities that affect habitat (including trapping, hunting, poaching, harassment, road kill, illegal kill levels, plant collections) and how does this affect terrestrial species?
Scale: Forest, Watershed, Project **RAP question numbers:** EF5, TW1, TW3
Indicators: Human activities on roads, law enforcement available, wildlife species present, sensitivity of those species to disturbance.
Data source: Data on species response to hunting and collection both legal and illegal. Identify problem areas in terms of poaching and theft and other illegal activities and what law enforcement is available for these areas.

For Forest Level: Develop data for effects to species from legal and illegal hunting or collections.
For Watershed and Project levels: Identify problem areas in terms of poaching and theft and other illegal activities. Identify law enforcement availability in the area.

Key Question: How does the road system directly affect unique communities or special features in the area and the species that occupy them?
Scale: Forest, Watershed, Project **RAP question numbers:** EF5, TW4
Indicators: Unique areas or habitat and susceptibility to human use.
Data source: Maps of special or unique habitats.

For Forest Level: Map key routes and determine which species of habitat of concern adjacent to these roads. Develop data on which species have habitat that will be affected by the road system.
For Watershed and Project levels: Identify and map special or unique habitat areas.

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GIS Sources

Roads – Cartographic Feature Files, with feature realignments based upon Digital Ortho Quads.

Late Successional Reserves – Delineated by Forest Ecosystem Management Assessment Team in Forest Service Pacific Northwest Regional Office, Portland Oregon at 1:250,000. Boundary realignment corrections done for boundaries coincident with other mapped boundaries at 1:24,000.

Watersheds – CALWATER from California Department of forestry, 1:24,000 scale.

Findings:

Wildlife Species

- Roads can add to habitat fragmentation. Analysis indicates that the Late-Successional Reserves are more affected by habitat fragmentation than areas outside of them. The impacts of habitat fragmentation are best conducted at the watershed or project level.
- Due to the narrow road width, low traffic density, and low rate of speed vehicles can travel on most forest roads, it is unlikely the roads will act as a barrier to terrestrial species movement. These same conditions will also result in low numbers in road kill animals.
- Road density was evaluated on a 5th field watershed basis, looking at all roads and just open roads. Only roads with the Forest Routed system were used for this analysis. The rating system was only designed to give priority to when a watershed should be reviewed. Ten watersheds have a

rating of high, with four of them being high both for all roads and open road density; six were rated as medium; and six were rated at low (refer to Table A3.4- 2). Impacts from road densities should be determined at the watershed and project level and should be designed to answer questions for the species of concern for those areas.

- Species sensitive to disturbance can be impacted by roads or by activities associated with or made accessible by roads. The impacts of disturbance should be reviewed at the watershed or project level.
- While roads provide access for illegal activities that can lead to habitat loss or physical removal of species, the level of impact of these actions have not been documented for the Forest.
- Habitat improvement projects can be accessed and completed safer and cheaper with a certain level of road networks. Roads can also be used to protect forest habitat with wildfire suppression and to aid in fuel reduction projects.

Need for Forest Plan Amendment

- There is a need to review the road density values used in the habitat capability models for the fisher and marten. The review should survey current subject matter literature to determine if the values in the capability models are appropriate or if they should be updated.

<u>Botanical Species: Rare and Sensitive Plants</u>

- Road maintenance can impact sensitive species located adjacent or within the road prism through direct removal of the plants or by changing hydrological patterns. There are three key route roads where changes in hydrologic flows are a concern. These are 24N21, M1b and M61.
- Soil stabilization work associated with road systems can involve the use of fertilizer and herb or forb seeds. In serpentine soils the use of fertilizer can adversely affect native species by temporarily stimulating the growth of undesirable introduced species. For key routes this would affect M22.
- Not all roads within the Forest boundary are managed by the Forest Service, so the potential exists for Forest Service sensitive species to be impacted by other groups' road maintenance or reconstruction activities. Not shown as an issue for key routes.

<u>Noxious Weeds and Exotic Pathogens</u>

- The Mendocino N.F. faces a serious loss of native flora and habitat due to noxious weed incursion and spread; there is ample evidence that vectors moving along road corridors act as the most significant mode of spread for non-native species.
    - Weeds are often restricted to the disturbed shoulder soil of the road corridor. Weeds spreading along the road corridor are a forest scale problem.

  - The road corridor can also act as a staging point for invasive weeds that spread into adjacent native habitats. Weeds leaving the road corridor and infesting native habitat is an incident, or project scale problem.
- There are a number of reasons why roads act as corridors of spread for noxious weeds; most occur at a forest scale.
  - Road shoulders consist of regularly disturbed soils: a prime characteristic of weedy habitat. Forest scale.
  - Roads attract vehicles, animals (domestic and wild), and humans that act as vectors of weed seed spread. Forest scale.
  - Recurring generations of seed producing weeds, combined with road maintenance such as grading and ditching, create deep and well-populated weed seed banks. Forest scale.
  - Road disturbance is not restricted to a corridor, roads can alter the microclimate surrounding them; this could occur at project, watershed, or forest scale.
- Although passenger vehicles have been found to carry weed seeds over great distances, the numbers of seeds found are so low that Forest resources are best spent on detecting and eradicating weed infestations as they occur (using weed surveys), rather than trying to control tourist vehicle movement into the forest. Both the movement of these vehicles, and the weed surveys occur at a forest scale.
- Any decommissioning of roads would be beneficial to weed control; however, these roads must be surveyed for several years after decommissioning since noxious plants and seed banks could persist, and would no longer be detected by a road survey. Roads would be decommissioned on a project scale.
- Sudden Oak Death (SOD), a condition caused by the fungal pathogen *Phytophthora ramorous*, has caused the death of thousands of oaks in California. Originally restricted to coastal sites, SOD did not appear to be a threat to xeric, interior landscapes such as the Mendocino N.F. However, SOD now appears to be moving inland; documented cases have been found as far inland as Napa and Solano counties. Although not confirmed, experts believe that SOD may have been found in Placer County, on the west side of the central valley. If this turns out to be the case, the Mendocino N.F. would be directly in the path of the spread of SOD. The Forest should be prepared to implement a number of measures to control and eradicate SOD; an infestation would be controlled on a watershed and forest scale.

Guidelines:

- Need for Forest Plan Amendment

- During review of management indicator species, need to determine if there is scientific information that can be used to validate or correct current road density values for fisher and marten habitat capability models.

- Identifying Opportunities and Setting Priorities

  - Use Table A3.4-2 (pg A3.4 – 9) to determine which watersheds have the highest priority for review to determine affects from road densities. Only the areas that rated high in both categories of all roads and open roads should have the highest priority (Thomes, Briscoe, Grindstone and Elder watersheds).

  - The forest Noxious Weed Coordinator should establish effective roadside vegetation management program centering on the following priorities:

    - Monitor and quickly treat aggressive alien species (Weeds of the Mendocino N.F. 2002) upon their initial occurrence in the forest.
    - Re-survey road weed eradication sites for a minimum of 5 years because of seed banks.
    - Create weed-poor buffer zones on roadsides leading to the Wildernesses by grading away from the Wilderness perimeter.

  - Consider the following criteria when prioritizing the decommissioning of unneeded roads:
    - Roads with little or no noxious weed infestation.
    - Spur roads within 1/2 mile of a wilderness area.
    - Backcountry spur roads located near sensitive plants or habitats.
    - Unclassified roads in inventoried roadless areas.

  - The spread of the SOD by vehicle/soil vector is a serious concern, and means of entrance to the forest will most likely occur along the road matrix. The occurrence of the pathogen in the forest could lead to quarantine, road closings, public education and signage, vehicle washing stations, and restrictions of use permits. The Mendocino N.F should be prepared to work closely with county, state and federal authorities in the event of a quarantine.

- Watershed and Project Scale Analysis

  - In addition to reviewing terrestrial species habitat fragmentation from roads, also review the width of the roads, and the kinds of cuts and fills. All of these factors can influence how much of the habitat is actually fragmented.

  - To determine effects of road density, the following type of information is needed:

    - When determining the amount of level one roads within the analysis area, make sure the roads are really closed to vehicles.
    - Include all roads in the area, including private roads.
    - Besides the amount of roads in an area, the duration and intensity of use is important for determining the effects of the roads. The timing of use may also be an important analysis factor.
    - Since wildlife species differ in their tolerance of road densities, the species of concern for the analysis area should be determined first and then the rating system developed to determine the affects to the species.
    - Assess the scale and intensity of road-related fragmentation as compared to other causes of fragmentation, such as timber harvest and wildfire. Evaluate whether road-related fragmentation is among the most limiting of causes, or if other causes must be addressed before reducing road density can be productive.
  - Determine which terrestrial species are in the area that are sensitive to disturbance and whether the habitat for the species is made accessible by the roads or is affected by the roads and associated activities.
  - Determine if unique habitat features exist in the area, such as serpentine soils, rocky outcropping or wet meadows. If present, then determine the habitat quality, its potential for supporting species of concern and the potential for impacts associated with roads.
  - Work with Forest Service law enforcement, game wardens and state biologists to determine the effects of illegal activities on local populations of terrestrial species.
  - Develop maps of plant populations to be avoided while conducting routine road maintenance. This document and local knowledge should be shared with both Forest Service and county road crews to help protect these sites. Development of an on-site posting system would also be helpful.
  - Work closely with neighboring County Agriculture Departments to identify road-related weed control problems.

- Construction
  - Whenever practicable, utilize the technique of stockpiling and redistributing local duff and topsoil during road construction. Whenever possible, post-road construction road bank stabilization and rehabilitation work should utilize the existing soil seedbanks and mycorrhizae that are well-adapted for that site. Redistributing the correct depth of soil and duff that has been stockpiled for up to one year can simplify and expedite efficient, site-adapted revegetation work during road-edge stabilization and re-habilitation of temporary roads.

Use of certified weed-free mulch and native seed from appropriate seed zones should be standard operating procedure during road stabilization and revegetation work. Weed-free cereal grain alternatives may be appropriate when existing soil seedbanks already include significant amounts of aggressive introduced species.

- California grown, certified noxious weed-free native seed from appropriate seed zones should be utilized to the extent possible and practical.

- Reconstruction
  - Stockpiling and redistribution of topsoil and duff should be implemented when possible during road reconstruction in order to assure that local seedbanks and mycorrhizae are utilized. The R-5 Native Plant Policy should be implemented whenever possible during road reconstruction, soil stabilization and rehabilitation work.

- Operation and Maintenance
  - In areas with serpentine soils, it will be important to make sure not to use fertilizer when doing soil stabilization work.
  - When conducting soil stabilization work that requires the use of seeding, it will important to work with a botanist to determine effects of the seeding on native plant species. As much as possible, it would be good to used local native plants for the stabilization work. If that is not possible, then the botanist can suggest other types of plants that should not displace native plants.
  - Work with the road managers to promote weed free road maintenance and construction.
    - If possible, do not “import soil” from unknown or roadside sources for use in road maintenance; it may carry a weed seed bank.
    - Preserve native seed banks by scraping topsoil to the side and replacing it on top of disturbed soil.
    - Remove, if possible, soil and seeds from construction equipment before leaving infested work sites.
    - Notify the Noxious Weed Coordinator of work sites involving significant soil disturbance so the site can be monitored in the future.
    - The need for vehicle washing stations should be considered during project-scale analysis.
  - During road maintenance avoid introducing or spreading weed seeds, and if possible preserve native seed banks. Non-native species seeded during road stabilization can out-compete and thereby cause the loss of native plant species.

- Closure & Decommissioning
  - Decommissioned roads are at risk of weed reinfestation, and should be surveyed annually for at least five years after closing to guard against weed occurrence, especially since drive-by surveys will no longer be possible.